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Taxonomic diversity and Ethnobotany of genus *Solanum* (Solanaceae) alongside Pir Panjal gradient, North-western Himalayas-Rajouri (J&K UT), India

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ABSTRACT

The present study is a comprehensive account of the genus *Solanum* (Solanaceae) from the Rajouri district of Jammu and Kashmir UT. The taxonomic account of six species recorded from the genus *Solanum* during the study period in the region is presented. Along with the taxonomic description, the updated nomenclature, synonym (if any), description, altitudinal range, distributional pattern, and Ethnomedicinal properties of all the species have been provided in the present study. The present study will be useful for scholars and researchers perusing biodiversity and ethnobotanical studies.

Keywords: Taxonomy, *Solanum*, Solanaceae, Diversity, Rajouri, J&K, India

1. INTRODUCTION

Solanaceae is a family of flowering plants that diversifies from annual and perennial herbs to vines, shrubs, and trees dispersed across all the continents except Antarctica (Yadav et al., 2016; Sarker & Rahman, 2016; Nahar & Rahman, 2016; Nath et al., 2017). Solanaceae is an important family of plants that comprises both economic as well as medicinal plants. Potato, Tomato, Eggplant, and Peppers are some of the most important cash crops that belong to the family of Solanaceae (Ghatak et al., 2017; Omar et al., 2021; Gautam & Adhikari, 2021; Bakar et al., 2021). On contrary, *Atropa*, *Hyoscyamus*, *Withania*, *Capsicum*, and *Nicotiana* are just some of the most important species of family Solanaceae that kick start the early stages of medicinal plant-based drug discovery and are often considered important in Ayurveda and Siddha herbal practices (Chowanski et al., 2016). *Solanum* (Linnaeus) is a diversified genus that belongs to the multiracial family Solanaceae. Genus *Solanum* comprises 3000–4000 species, which spread across 90 genera. Species belonging to the family Solanaceae embrace a spacious range of terrestrial habitats from deserts

to rainforests (Knapp et al., 2004). In India, the genus *Solanum* is represented by 42 species that are distributed throughout the country (Deb, 1980). The genus embraces an important economic value with many species as a source of edible vegetables and fruits, while most of them possess Ethnomedicinal properties (Muthoni et al., 2012). Kashmir valley evince a rich floral diversity. A number of surveys have been reported to unveil the medicinal flora of Jammu and Kashmir in the recent past. However, many areas are still unexplored and many species are awaiting discovery. (Mochi and Riyaz, 2021). Jammu and Kashmir being part of the western Himalayas is home to more than 1123 different medicinal plants which embrace immense medicinal properties (Tali et al., 2019) and nurtures a great diversity of medicinal plants used in traditional health care systems by local and tribal communities for thousands of years (Riyaz et al., 2021). Traditional plant-based medicines are the only means of primary health care among people from different rural and remote areas. For curing various health ailments and the diseases of livestock, Medicinal plants has been used by the Gujjar and Bakkerwal tribes in Rajouri and Poonch districts of Jammu and Kashmir, India since time immemorial (Shah et al., 2015). Due to the exuberant growth of high-value medicinal plants in the nearby forests areas, the tribal communities of this region are still using folk medicines primarily for the treatment of various health ailments. The present study intended to assemble the taxonomy and ethnobotany of the genus *Solanum* from the Rajouri district of Jammu and Kashmir UT.

2. MATERIALS AND METHODS

District Rajouri is situated at the foothills of Pir Panjal Range; the western part of the Jammu division and shares its boundaries with district Poonch in North; district Jammu in the South, Udhampur in East and Mirpur (Pakistan) in the West. The area covers 2630 km², lying between 30°50' N to 33°03' N longitude and 74° E to 74°10' E latitude. (Bi et al., 2018). The area is rich in floral diversity having both economic and medicinal properties. The genus *Solanum* exhibits great diversity in many tehsils of the Rajouri District, which mostly occur in terrestrial habitats. Regardless of being one of the most interesting genera, a diminutive taxonomical investigation has been accomplished in the genus *Solanum* from the study area. For the collection of plant specimens, four different locations were surveyed in the Rajouri District viz. Fatehpur (33° 25'27"N 74° 19' 24"E), Dhanidhar Fort (33° 23'07"N 74° 19' 17"E), Shahdra Sharief (33° 33'07"N 74° 20' 32"E) and Panja Chowk (33° 21'39"N 74° 19' 46"E).

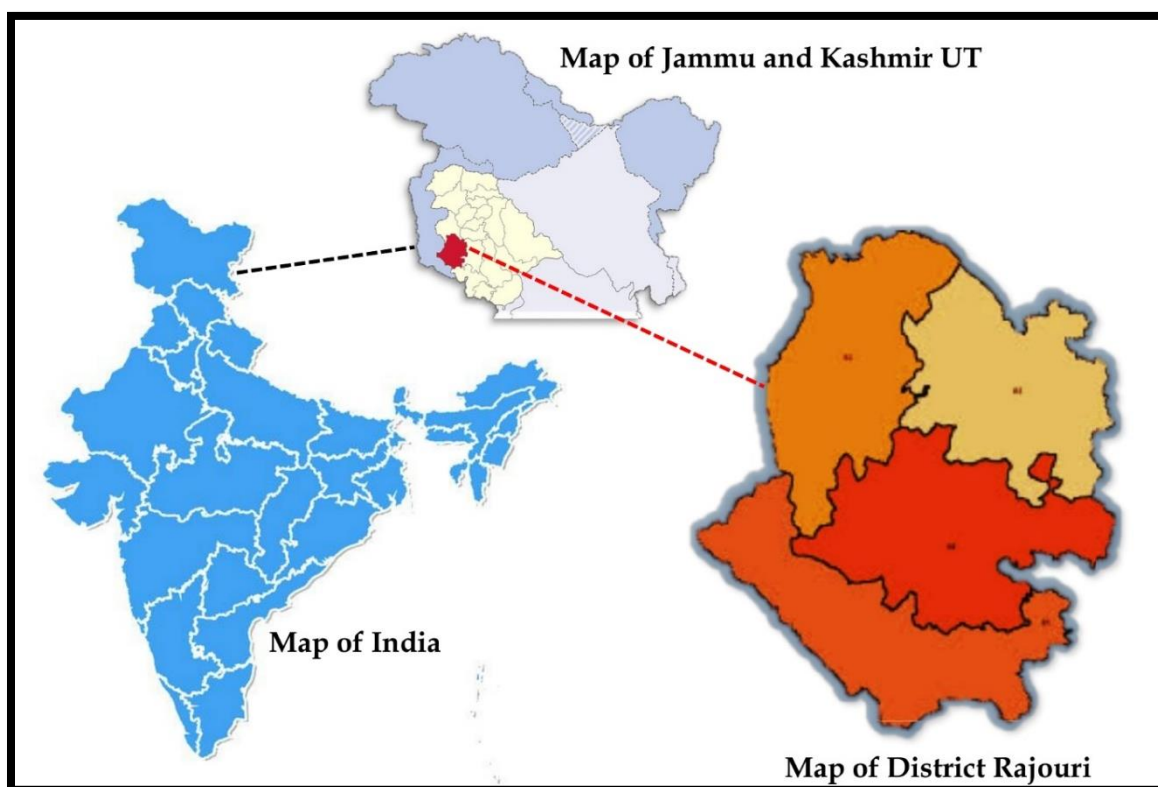


Fig. 1 Map of the study area

The present work is based on a collection and record of plant species from the genus *Solanum* from the Rajouri district of Jammu and Kashmir UT. During collection, the study area was surveyed in depth ensuring collection of required plant material in the flowering as well as fruiting stage. Periodic field trips were undertaken in different seasons for collection of different stages of plant

material. The collected plants were dried and preserved using herbarium techniques, Plant specimens were identified with the help of specimens deposited in the herbarium of BGSBU. Proper identification of the specimens was further given by comparison of specimens with the information available on online databases like e-Flora of India, Pakistan, China, and Plants of World online (POWO). The altitudinal range for all the collected specimens is been provided as well. Information regarding their medicinal value has been gathered from locals of the explored areas and folk uses were collected from different online herbal databases.

3. RESULTS AND DISCUSSION

At present stage of exploration, the genus *Solanum* is represented by six species in Rajouri District of Jammu and Kashmir UT. Each species has been provided with valid scientific name followed by author citation, Synonym (if any), brief Taxonomic treatment, flowering and fruiting stage, geographical location including altitudinal range, distribution and ecology.

1. *Solanum erianthum* D.Don, Prodr.Fl.Nepal .96.1825. [Solanaceae]

Common name: Potato Tree

Synonym: *Solanum verbascifolium* auctt .non L; Clarke, *Solanum erianthum* var. *adulterinum* (Ham.ex G. Don) Bakaer and Simmonds

Vernacular Name: Ban Tamakhu

Diagnostic Characters: Shrub or small tree up to 4 m tall. Leaves ovate- elliptical, margin wavy; Flowers are star shaped, white, anthers oblong; Fruit round green berry, globose, dull yellow when ripe.

Distribution: Native to South America and widely distributed in Tropical Asia, South Asia. India: Haryana, Pune, Bihar, Uttarakhand, Rajouri (Jammu and Kashmir). (eFlora of India <https://efloraindia.bsi.gov.in/eFlora/homePage.action> Accessed on 21-01-2022).

Flowering period: Throughout the year

Fruiting Period: November to December

Habitat: Roadsides, gardens, Crop fields.

Exciccata: INDIA, Jammu and Kashmir, Rajouri district, near dhanidhar fort 33° 23' 15" E 74° 19' 50", 1700 m, [SEEMA- 013] dated 6.05.2021

Uses: In Nigeria, The leaves are used for the treatment of Cancer and Malaria. The stems and roots are also used to elevate rheumatism and cold. Roots are used to cure stomachache and abdominal pain (Chen et al., 2013).

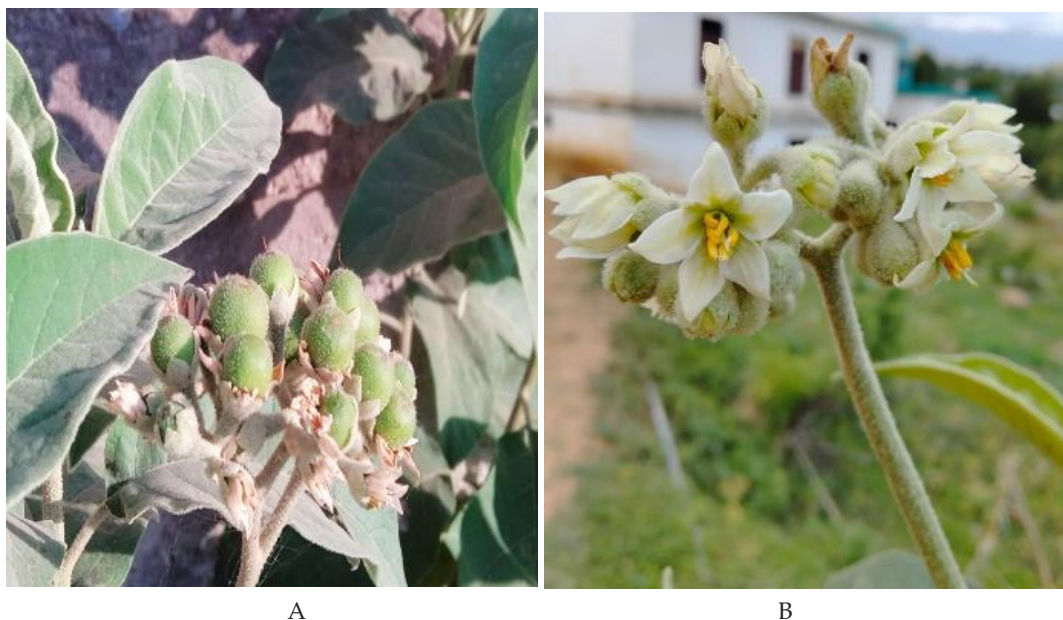


Figure 2. *Solanum erianthum*, Fruit Flower (A) and Flower (B)

2. *Solanum nigrum* L., Sp. pl:186.1753 [Solanaceae]

Synonym(s): *Solanum nigrum* var *atriplicifolium* G.Meyer.

Common name: European Black Night shade.

Vernacular Name: Kaambli Ghaas'e

Diagnostic Characters: A plant grows up to 60 cm, branched, erect; leaves alternate, ovate, deep green, margin bluntly toothed; Flower white, yellow colored centre; berries green, turn black when ripened.

Distribution: Native to Old World Tropics. India: Andhra Pradesh, Telangana, Karnataka, Maharashtra, Odisha, Tamil Nadu, Jammu and Kashmir (Flora of Peninsular India <http://flora-peninsula-indica.ces.iisc.ac.in/>) Accessed on 21-01-2022.

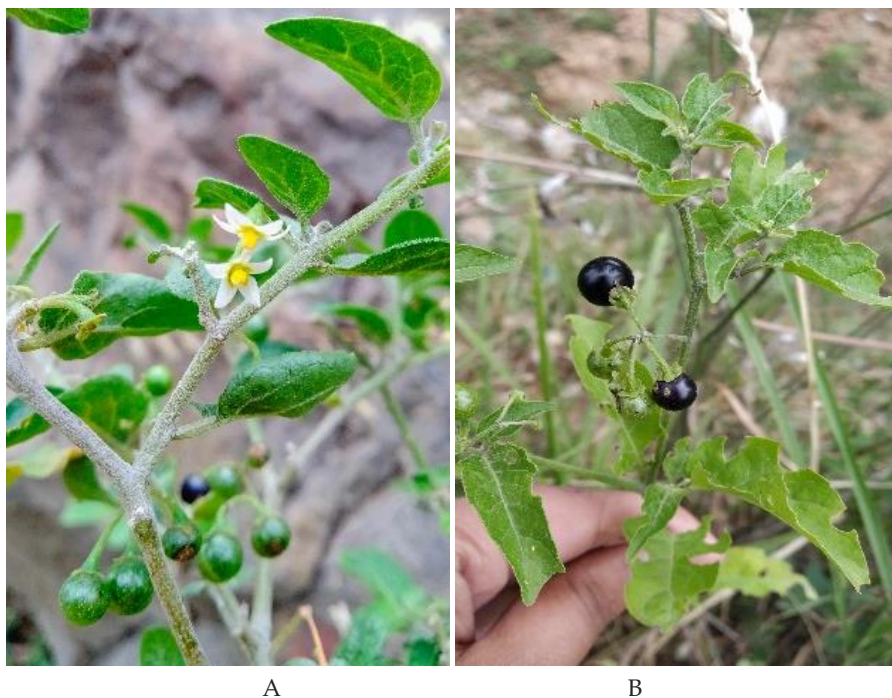
Flowering period: July- September.

Fruiting period: August- October

Habitat: Roadsides, gardens, crop field, disturbed sites.

Uses: *Solanum nigrum* berry decoction is used to treat cough, diarrhea, inflammations and skin diseases. It has Anti-oxidative, anti-inflammatory and anti-pyretic properties; Leaves are used to cure rheumatic joints, skin disorders (Rani et al., 2017).

Exsiccata: INDIA, Jammu and Kashmir, Rajouri district, near Panja Chowk 33° 23' 15" E 74° 19' 50", 1600 m, [SEEMA- 015] dated 15.05.2021.



A B
Figure 2. *Solanum nigrum*, Flower (A) and Fruit (B)

3. *Solanum villosum* Mill., Gard. Dict. ed. 8: Solanum no. 2. 1768. [Solanaceae]

Synonym(s): *Solanum humile* Bernh. Ex Wild, *Solanum alatum* Moench; *Solanum luteum* Mill.; *Solanum luteum* subsp. *alatum* (Moench) Dostal

Common name: Red nightshade

Vernacular Name: Koieer

Diagnostic Characters: Erect much-branched herb; leaves ovate- elliptic, alternate, margin entire or lobed, slightly pubescent; flowers white, corolla white- 5 lobed, stamens yellow- 5 in number; Berries orange or orange- red.

Distribution: Native to South America. India: Andhra Pradesh, Karnataka, Kerala, Odisha, Tamil Nadu, Jammu and Kashmir (<http://flora-peninsula-indica.ces.iisc.ac.in/>, <https://efloraindia.bsi.gov.in/eFlora/homePage.action>) Accessed on 21-01-2022.

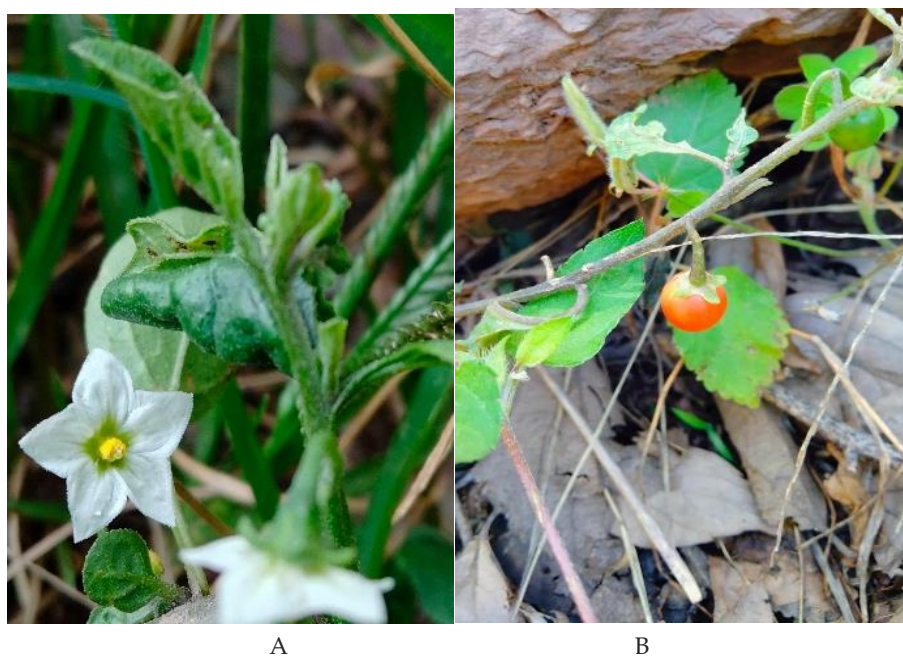
Flowering period: October

Fruiting period: Jan- Feb

Habitat: Roadsides, crop field

Uses: Whole plant is commonly used for treatment of leucorrhoea, nappy rash, wounds, and cold sores as *Solanum villosum* have multiple medicinal uses in an Ayurveda. The herb is used for soreness in eyes in Kenya; unripe fruits are used to soothe toothache (Zahara et al., 2019).

Exsiccata: INDIA, Jammu and Kashmir, Rajouri district, Shahdra Sharief 30° 23' 15" E 74° 19' 50", 1700 m, [SEEMA- 007] dated 23.05.2021



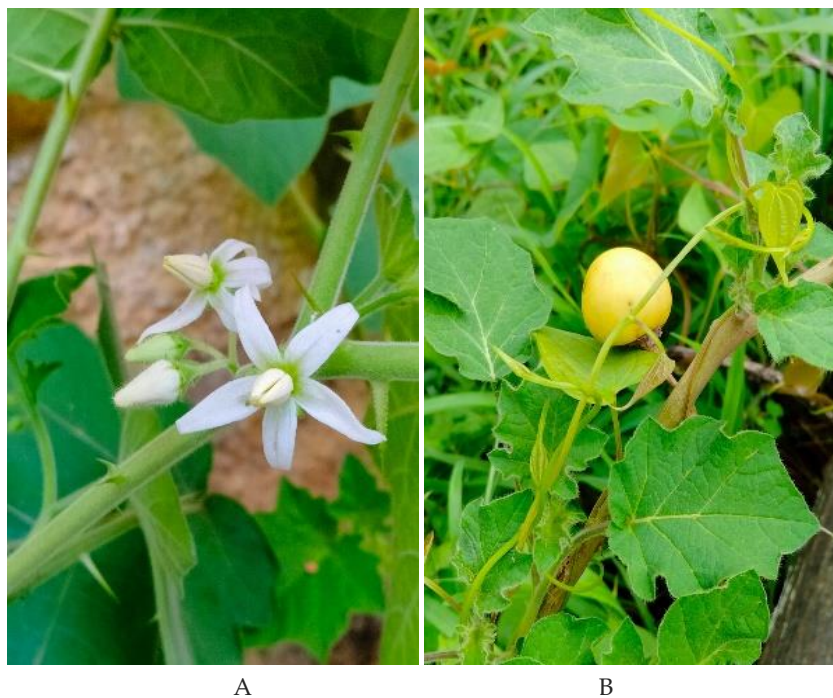
A B
Figure 2. *Solanum villosum*, Flower (A) and Fruit (B)

4. *Solanum Viarum* Dunal, Prodr. 13(1): 240 240 1852. [Solanaceae]

Synonym(s): *Solanum chloranthum* DC.; *Solanum khasianum* var. *chatterjeeanum* Sengupta; *Solanum reflexum* Schrank; *Solanum viridiflorum* Ruiz & Pav.)

Common name: Tropical soda apple

Vernacular Name: Bheij vaangun



A B
Figure 2. *Solanum viarum*, Flower (A) and Fruit (B)

Diagnostic Characters: Perennial shrub, Prickly stem; Leaves alternate, ovate, prickly, hairs on both surfaces; Flowers white, 5 petaled; Fruit watermelon shaped.

Distribution: Native to South America. India: Andhra Pradesh, Kerala, Odisha, Tamil Nadu, (Flora of Peninsular India) Accessed on 21-01-2022. Maharashtra, Kullu Manali, Haryana and Jammu and Kashmir (Rajouri) (<https://efloraindia.bsi.gov.in/eFlora/homePage.action>) Accessed on 21-01-2022.

Flowering period: July- August.

Fruiting period: November

Habitat: Overgrazed areas, Roadsides.

Medicinal Uses: Extract of *Solanum viarum* Dunal leaves has analgesic and antipyretic properties (Kausar & Singh, 2018).

Exsiccata: INDIA, Jammu and Kashmir, Rajouri district, Fatehpur 32° 22' 12" E 70° 15' 56", 1600 m, [SEEMA- 012] dated 24.07.2021

5. *Solanum pseudocapsicum* L., [Solanaceae] Sp. Pl., 184, 1754 Bailey, Man. Cult. Pl. 868, 1949; Hortus Third, 1055, 1976; Dassanayake & Fosberg, Revised Handbook Flora of Ceylon, vol. VI, 386, 1987.

Synonym(s): *Solanum capsicastrum* Link ex Schauer.

Common name: Winter cherry

Vernacular Name: Bihee.

Diagnostic Characters: An erect shrub, leaves lanceolate to elliptic- ovate; Flowers white; Fruit berries globose, scarlet red.

Flowering period: September-October.

Fruiting period: June- July.

Habitat: Wastelands, roadsides.

Medicinal Uses: *Solanum pseudocapsicum* is used in homeopathy medicine to cure acute lower abdomen pain and to treat somnolence. It has strong cytotoxic, anticancer, hepatoprotective, antimicrobial, antihypertensive, antispasmodic and antiviral properties (Badami et al., 2005).

Distribution: India: Kerala, Tamil Nadu (<http://flora-peninsula-indica.ces.iisc.ac.in/>) Accessed on 21-01-2022.

Exsiccata: INDIA, Jammu and Kashmir, Rajouri district, Fatehpur 33° 23' 15" E 74° 19' 50", 2000 m, [SEEMA- 011] dated 15.05.2021



A B
Figure 2. *Solanum pseudocapsicum*, Flower (A) and Fruit (B)

6. *Solanum virginianum* L. Sp. pl. 1:187. 1753 (Mant. pl. 2:340. 1771, as "*virginicum*") [Solanaceae]

Synonym(s): *Solanum surattense* Burm. f.;(=) *Solanum xanthocarpum* Schrad.; *Solanum mairei* H. Lév.)

Common name: Yellow fruit nightshade

Vernacular Name: Gul-khar

Diagnostic Characters: Thorny nightshade is an herb, erect or creeping; Leaves green alternate, prickly, margin lobed; Flowers blue- purple; Fruit berries globose, pale yellow colored.

Distribution: China, Afghanistan, India, S Japan, Malaysia, Nepal, Sri Lanka, Thailand, Vietnam; Africa, SW Asia, Pacific Islands. India: New Delhi, Chamba (Himachal Pradesh), Maharashtra, Pune, Maihar (M.P), Uttarakhand, Tami Nadu, Jammu and Kashmir. (<https://efloraindia.bsi.gov.in/eFlora/homePage.action>) Accessed on 21-01-2022.

Uses: Extract of *S. virginianum* have antibacterial activity used in the treatment of diseases caused by pathogenic bacteria. It has natural antioxidant properties having effectiveness in the prevention and control of oxidative damage caused by free radicals. The plant is used as a natural insecticide to control insect vectors that are responsible for various diseases (Kekuda et al., 2017).

Flowering period: November

Fruiting period: June-September

Habitat: Roadsides, Wastelands.

Exsiccata: INDIA, Jammu and Kashmir, Rajouri district, Fatehpur 30° 20' 15" E 73° 17' 53", 1800 m, [SEEMA- 009] dated 23.05. 2021.

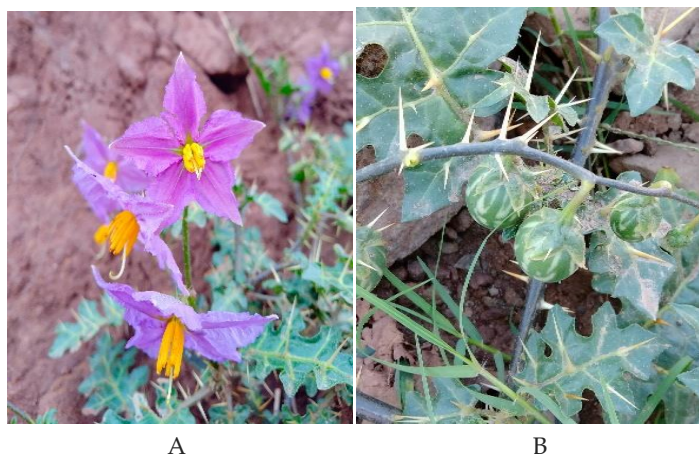


Figure 2. *Solanum surratense*, Flower (A) and Fruit (B)

District Rajouri is located at the foothills of Pir Panjal Himalayas, which is a minimal floral contemplated region in Jammu and Kashmir. A brief study about three *Solanum* species have been discussed earlier (Dar et al., 2014). In the present study, the taxonomic diversity of *Solanum* species was intended with a view to ease documentation of their overall floristic diversity. Our surveys and collections made from different locations of Rajouri from last Three years was assembled and we have recorded six *Solanum* species and along with their taxonomic description we have provided their Ethanomedicinal uses and traditional knowledge taken from the local people.

4. CONCLUSION

Based on the present study, the genus *Solanum* is represented by six species. The present study investigates that these species are mostly confined to roadsides, forestlands and crop fields in Kashmir region. Based on our field observations over the last three years, we have observed that locals use these plant species to treat various types of health ailments. Due to their high medicinal value, these species are now rarely found. With increasing anthropogenic activities like urbanization and industrialization, deforestation, the plant diversity in the region has been affected largely. There is a dire need to conserve both flora and fauna and with the present study as a whole documentation provides a way to kick start the biodiversity monitoring and conservation of the plant species particularly the medicinal plants.

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Ethical approval

The ethical guidelines for plants & plant materials are followed in the study for collection & identification. A diminutive taxonomical investigation has been accomplished in the genus *Solanum* from the study area. For the collection of plant specimens, four different locations were surveyed in the Rajouri District of Jammu and Kashmir UT. Plant specimens were identified with the help of specimens deposited in the herbarium of BGSBU. Proper identification of the specimens was further given by comparison of specimens with the information available on online databases like e-Flora of India, Pakistan, China, and Plants of World online (POWO).

Funding: This study has not received any external funding.

Conflicts of interests: The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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